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Rules of Law, Laws of Science

Wai Chee Dimock*

My Essay is a response to legal realism,¹ to its well-known arguments against “rules of law.” Legal realism, seeing itself as an empirical practice, was not convinced that there could be any set of rules, formalized on the grounds of logic, that would have a clear determinative power on the course of legal action or, more narrowly, on the outcome of litigated cases. The decisions made inside the courtroom—the mental processes of judges and juries—are supposedly guided by rules. Realists argued that they are actually guided by a combination of factors, some social and some idiosyncratic, harnessed to no set protocol. They are not subject to the generalizability and predictability that legal rules presuppose.

That very presupposition, realists said, creates a gap, a vexing lack of correspondence, between the language of the law and the world it purports to describe. As a formal system, law operates as a propositional universe made up of highly technical terms—estoppel, surety, laches, due process, and others—accompanied by a set of rules governing their operation. Law is essentially definitional in this sense: It comes into being through the specialized meanings of words. The logical relations between these specialized meanings give it an internal order, a way to classify cases into actionable categories. These categories, because they are definitionally derived, are answerable only to their internal logic, not to the specific features of actual disputes. They capture those specific features only imperfectly, sometimes not at all. They are integral and unassailable, but hollowly so. In the emphatic words of Karl Llewellyn, “Legal rules mean, of themselves, next to nothing. They are verbal formulae, partly conveying a wished-for direction and ideal. But they are, to law students, empty.”² Felix Cohen was even more blunt. Jurisprudence, as the decisional rules

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1. Legal realism is an umbrella term, with loosely-defined membership. Karl Llewellyn supplies a good working list: W. Bingham, C.E. Clark, W.W. Cook, A.L. Corbin, W.O. Douglas, J. Francis, J. Frank, L. Green, J.C. Hutcheson, S. Klaus, K.N. Llewellyn, E.G. Lorenzen, U. Moore, H. Oliphant, E.W. Patterson, T.R. Powell, M. Radin, W.A. Sturges, L.A. Tulin, H.E. Yntema. See Karl Llewellyn, *Some Realism about Realism—Responding to Dean Pound*, 44 HARV. L. REV. 1222, 1257-59 (1931).

2. Karl Llewellyn, *On What Is Wrong with So-Called Legal Education*, 35 COLUM. L. REV. 651, 669 (1935).

between linguistic entities, “is a special branch of the science of transcendental nonsense.”³

Of course, as the realists were the first to remind us, transcendental nonsense can wield enormous power in the world. What gives it this power is, in part, a popular conception of law, honoring it for the very thing that makes it nonsensical to the realists. Law, popularly understood, is an adjudicative vehicle generalized and pre-existing, a whole cloth already in place in advance of any application to specific cases. Jerome Frank summarized this view as follows:

Law is a complete body of rules existing from time immemorial and unchangeable except to the limited extent that legislatures have changed the rules by enacted statutes. Legislatures are expressly empowered thus to change the law. But the judges are not to make or change the law but to apply it. The law, ready-made, pre-exists the judicial decisions.⁴

Law, in the minds of most laymen and most lawyers, enjoys a sequential privilege. It is anterior to what it adjudicates. All its necessary provisions are either already there, or deducible from what is there. Its logical sweep—its extendability to new contexts as inferences from what is preexisting—means that it can be counted on to cover any potential case that might arise. By virtue of its antecedence, then, law carries within itself a projective guarantee. Its rules can be projected into the future, can be preserved in a continually generalizable (and thus continually reusable) form, not dependent on and not limited to one specific context of application.

LANGDELL'S LEGAL SCIENCE

This popular view of law was certainly irritating to the realists. But a more immediate and more powerful irritant went by the name of the “case method,” a pedagogy which, Karl Llewellyn said, was “blind, inept, factory-ridden, wasteful, defective and empty.”⁵ This offending pedagogy

3. Felix Cohen, *Transcendental Nonsense and the Functional Approach*, 35 COLUM. L. REV. 809, 821 (1935).

4. JEROME FRANK, *LAW AND THE MODERN MIND* 35 (Anchor Books 1963) (1930).

5. Llewellyn, *supra* note 2, at 653; see also Jerome Frank, *Why Not a Clinical Lawyers-School?* 81 U. PA. L. REV. 903 (1933). Frank portrayed Langdell as a bizarre character with

an obsessive and almost exclusive interest in books. . . . The lawyer-client relation, the numerous non-rational factors involved in persuasion of a judge at a trial, the face-to-face appeals to the emotions of juries, the elements that go to make up what is loosely known as the “atmosphere” of a case—everything that is undisclosed in judicial opinion—was virtually unknown (and was therefore meaningless) to Langdell. . . . The so-called case system (the “Harvard system” which some university law schools adopted and by which some of them are still largely dominated) was the expression of the strange character of a cloistered, retiring bookish man.

Id. at 907. Contemporary observers saw a direct connection as well between the realists' critique of rules and the pedagogy of the case method. See, for instance, John Dickinson, *Legal Rules: Their*

was the brainchild of Christopher Columbus Langdell. Langdell was named the first Dean of the Harvard Law School in 1870; he taught his first case method class that fall.⁶ This was soon adopted by law schools nationwide; it became a “classical orthodoxy,” dominating legal education for almost a century.⁷ In promoting the case method, Langdell had one special goal in mind. Law was to be made into a science—a logical enterprise, a combination of induction and deduction—laying claim to just that generalizability and predictability popularly attributed to it. Like science, law was to proceed, inductively, from observable phenomena to fundamental principles, and back again, deductively now, from these fundamental principles to more observable phenomena.⁸ The compilation of cases was not an idle compilation. It was to be an exercise in logic, based on the assumption that, once these cases were amassed, once they were classified according to the proper legal categories, broad underlying doctrines would be revealed, applicable to all disputes in existence and in potentia. Langdell himself was explicit on this point:

Law, considered as a science, consists of certain principles or doctrines. To have such a mastery of these as to be able to apply them with constant facility and certainty to the ever-tangled skein of human affairs, is what constitutes a true lawyer. . . . The growth [of these doctrines] is to be traced in the main through a series of cases; and much the shortest and best, if not the only, way of mastering the doctrine effectively is by studying the cases in which it is embodied.⁹

The study of case law was similar to the collecting of scientific data. In both, the exercise was meaningful only because the data could be

Function in the Process of Decision, 79 U. PA. L. REV. 833 (1931). Perhaps there was a degree of institutional rivalry as well. Legal realism was associated mostly with two law schools: Columbia and Yale. See also LAURA KALMAN, *LEGAL REALISM AT YALE: 1927-1960*, at 67-144 (1986); WILLIAM TWINING, *KARL LLEWELLYN AND THE REALIST MOVEMENT* (1973).

6. CHARLES WARREN, *HISTORY OF THE HARVARD LAW SCHOOL*, 359, 363, 372-73 (1908).

7. Thomas C. Grey, *Langdell's Orthodoxy*, U. PITT. L. REV., Fall 1983, at 1. For the spread of the Langdellian model beyond Harvard, see Robert Stevens, *Two Cheers for 1870: The American Law School*, in *LAW IN AMERICAN HISTORY* 405 (Donald Fleming & Bernard Bailyn eds., 1971), expanded into his *LAW SCHOOL: LEGAL EDUCATION IN AMERICA FROM THE 1850S TO THE 1980S* (1983). Bruce Ackerman sees three generations of dissent from the classical orthodoxy: first, Holmes and Thayer at the end of the nineteenth century, then Brandeis, Frankfurter, and Pound in the early twentieth, and finally the legal realists in the late 1920s and 1930s. Ackerman sees the demise of the Langdellian model in the rise of the “Legal Process School,” including figures such as Lon Fuller, Paul Freund, Henry Hart, Herbert Wechsler, Alexander Bickel, and Harry Wellington. See Bruce Ackerman, *Jerome Frank's Law and the Modern Mind*, 103 DAEDALUS 119 (1974) (book review).

8. For a lucid analysis of the interlocking relation between induction and deduction, not just in Langdell but most of all in John Stuart Mill's *SYSTEM OF LOGIC* (1843), see Grey, *supra* note 7, at 19. For an account of the uses of induction and deduction in earlier American legal thought, see PERRY MILLER, *THE LIFE OF THE MIND IN AMERICA: FROM THE REVOLUTION TO THE CIVIL WAR* 156-64 (1965). For a critique of induction by a philosopher often cited by legal realists, see John Dewey, *Logical Method and Law*, 10 CORNELL L. REV. 17 (1924). For critiques by realists, see, among others, Walter Wheeler Cook, *Scientific Method and the Law*, 13 A.B.A. J. 303-09 (1927).

9. CHRISTOPHER COLUMBUS LANGDELL, *Preface* to *CASES ON THE LAW OF CONTRACTS*, at ix (2d. ed. 1879).

extended by induction and deduction, which is to say, could be used to uncover something more basic, a conceptual foundation predictive of any individual instance. Sir Frederick Pollock, Professor of Law at Oxford and an admirer of Langdell's, made this claim even more forcefully.¹⁰ In an essay with a self-explanatory title, *The Science of Case-Law*, Pollock wrote:

The ultimate object of natural science is to predict events—to say with approximate accuracy what will happen under given conditions. Every special department of science occupies itself with predicting events of a particular kind. . . . The object of legal science, as we understand it, is likewise to predict events. The particular kind of events it seeks to predict are the decisions of courts of justice.¹¹

The predictive claim of case law clearly orients it towards the future, but actually this claim is based on a symmetrical claim about past decisions as well: decisions that can be generalized, and whose generalizations will hold for all cases to come. At the heart of case law is thus the principle of *stare decisis*—literally, to stand by things decided—the principle that subjects all new cases to the logical consistency elaborated by precedents. In theory, precedents comprise all past decisions; in practice, what this means is an almost exclusive reliance on appellate opinions, since legal reasoning is the central feature, not of the trial courts (charged with fact-finding), but of the upper courts, ruling on the legal merit of lower-court judgments.¹² These appellate opinions provided case law with its raw data as well as its pedagogic method. Armed with these common law precedents, and extending these scientifically with an inductive and deductive logic, “rules of law” would indeed carry a broad power to generalize and predict.

Langdell and his colleagues were not the first to hanker after the logical sweep of a legal “science.” Others had also gestured in this direction: Bacon, Blackstone, Mansfield, and Story, to name just a few.¹³ Still, no one had been quite as determined. And the impetus for it did not seem to have stemmed from the practice of law itself. As Robert Gordon points out, law in the late nineteenth century benefited from its own

10. In the 1870s and 1880s, there were close ties between the law faculty at Oxford and the American Langdellian school. See F.H. LAWSON, *THE OXFORD LAW SCHOOL, 1850-1965*, at 69-85 (1968).

11. FREDERICK POLLOCK, *The Science of Case-Law*, in *ESSAYS IN JURISPRUDENCE AND ETHICS* 237, 238 (1882).

12. The reliance of the Langdellian model on appellate opinions is now a commonplace. Legal realists remarked on this practice from the very outset. See, e.g., FRANK, *supra* note 4, at xxvii-xxix; Frank, *supra* note 5, at 910-11.

13. MILLER, *supra* note 8, at 156-87. William LaPiana, in particular, emphasizes the continuity between Langdell's legal science and the legal science of Story. See WILLIAM LAPIANA, *LOGIC AND EXPERIENCE: THE ORIGIN OF MODERN AMERICAN LEGAL EDUCATION* (1994). For earlier entanglements between law and science, see Barbara J. Shapiro, *Law and Science in Seventeenth Century England*, 21 *STAN. L. REV.* 727 (1969).

inconsistencies. The day-to-day work of the lawyer was tied to the different statutes of different jurisdictions and consisted mostly of mundane things: drafting of charters, leases, mortgages, bond indentures. In such cases, “lawyers were most likely to use litigation as a tactic for harassment or delay, the aim being to avoid any resolution on the merits of the case. Toward that end, the unscientific, haphazard, and heterogeneous nature of unreformed state law and procedure was a positive advantage.”¹⁴ Langdell’s legal science was not much in demand in the law office. Its ascendancy had more to do with academic politics, with a growing professionalism that was reshaping the structure and aims of American higher education.¹⁵ Langdell saw himself as a much-needed reformer, saving legal education from an ossified pedagogy and putting it on a surer and sounder foundation. In a speech given in 1886, on the 250th anniversary of the founding of Harvard College, he explained what this reform meant to law and to its institutional home, the university:

[It] was indispensable to establish at least two things: first, that law is a science; secondly, that all the available materials of that science are contained in printed books. If law be not a science, a university will best consult its own dignity in declining to teach it. If it be not a science, it is a species of handicraft, and may best be learned by serving an apprenticeship to one who practices it. If it be a science, it will scarcely be disputed that it is one of the greatest and most difficult of sciences, and that it needs all the light that the most enlightened seat of learning can throw upon it. . . . If printed books are the ultimate sources of all legal knowledge; if every student who would obtain any mastery of law as a science must resort to these ultimate sources. . . . then a university, and a university alone, can furnish every possible facility for teaching and learning law.¹⁶

What was at stake, in claiming law as a science, was nothing less than the identity of the legal profession: what sort of profession it was going to be, where its training was to be done, how its membership was to be reproduced. As Langdell saw it, there were two alternatives. Either law was to be a craft, reproduced through an apprentice system; or it was to be a branch of learning, in which case it could only be reproduced through books, reproduced at places where books were abundantly collected. Law, Langdell insisted, was the province of the university. It must be organized

14. Robert W. Gordon, *Legal Thought and Legal Practice in the Age of American Enterprise, 1870-1920*, in *PROFESSIONS AND PROFESSIONAL IDEOLOGIES IN AMERICA* 70 (Gerald L. Geison ed., 1983).

15. Anthony Chase, in fact, traces the pedagogic reforms at the Harvard Law School less to Langdell than to Charles Eliot, President of Harvard. See Anthony Chase, *The Birth of the Modern Law School*, 23 *AM. J. LEGAL HIST.* 329 (1979).

16. CHRISTOPHER COLUMBUS LANGDELL, *RECORD FOR THE COMMEMORATION ON THE TWO HUNDRED AND FIFTIETH ANNIVERSARY OF THE FOUNDING OF HARVARD COLLEGE (1887)*, quoted in ARTHUR E. SUTHERLAND, *THE LAW AT HARVARD* 175 (1967).

as an academic discipline; its practitioners must be formally trained, as scientists were. And so, “the library is the proper workshop of professors and students alike; it is to us all that the laboratories of the university are to the chemists and physicists, all that the museum of natural history is to the zoologists, all that the botanical garden is to the botanist.”¹⁷

The birth of the modern law school began with an emphatic nod to science as a disciplinary model. At its most ambitious, this legal science called for a sweeping overhaul of the entire edifice of law, a thoroughgoing systematization. This would culminate in 1923 in the founding of the American Law Institute, made up of law professors and prominent members of the bench and bar, to embark on a massive undertaking, a “Restatement of the Law.” The Restatement project, at heart a taxonomic dream, was a direct response to a problem that was the bane of stare decisis, namely, the staggering volume and conflicting nature of precedents.¹⁸ As the Institute said,

In the United States, each of the forty-eight states has its own system of courts making law every day. In addition, there are the federal courts. Decisions of these courts are the precedents for future cases. . . . A lawyer working on a case must not only find, read and digest the cases, past and present, of all the courts in his state, but where the proposition he wants to urge is without firm precedent there, he must research the law of all other states and the federal courts. Even after all this work, he may not find a clear-cut authority.¹⁹

Law was sorely unscientific at the beginning of the twentieth century; the American Law Institute was to rectify that. Its goal was to reconcile as many cases as possible, ironing out contradictions and getting rid of hopeless anomalies, so that case law would indeed be generalizable, would express “as nearly as possible the rules which courts will apply today. These rules govern not only situations which have already arisen in specific cases, but by analogy all rules which would apply in situations which may arise for the first time.”²⁰

But the generalization of case law had, in some sense, already been taking place for almost half a century. From the 1870s on, as Morton Horwitz points out, “functional categories useful to practicing lawyers” in contract and torts were done away with, replaced by “general concepts that submerged the concrete particularity of the previous organizing

17. *Id.*

18. Grant Gilmore sees this as the roots of legal realism as well. See Grant Gilmore, *Legal Realism: Its Cause and Cure*, 70 YALE L.J. 1037, 1041-42 (1961).

19. Herbert F. Goodrich, *The Story of the American Law Institute*, WASH. U. L.Q., June 1951, at 283, 286.

20. *Id.* at 220.

schemes.”²¹ Different branches of contract law, for instance, were reclassified under such broad headings as “offer and acceptance” and “consideration.”²² In torts, the concept of “negligence” was taken from its hitherto narrow meaning—as the failure to perform a specific duty imposed by statute or contract—and broadened instead into a comprehensive rule: the logical antecedent to “fault” and the limiting condition for liability. In this way, negligence and fault were shown to be the foundation of tort law, underwriting the entire field and descriptive of all its actions. This newly minted foundation radically raised the standard of proof for the reward of damages. Common carriers—railroads—were no longer held liable for injuries regardless of fault, as they had once been under strict liability. Instead, a new prerequisite came into play—a demonstration of “negligence”—narrowing the scope of recoverable injuries and, in the same measure, broadening the scope of legal reasoning. Cases such as *Brown v. Collins* and *Losee v. Buchanan* showed how this worked.²³ Torts was indeed a branch of law with an unusual degree of conceptual order. As such, it was the highpoint of legal science, the showcase of its logic.²⁴ And, by and large, legal science did not venture much beyond torts and other areas of private law.²⁵ Some, however, have seen it as a shaping force on public law as well, tracing the laissez-faire constitutionalism of the *Lochner* era also to its conceptual universe.²⁶

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And yet, for all its rhetoric, the exact connection between this legal “science” and the natural sciences remains an open question. Langdell’s

21. MORTON HORWITZ, *THE TRANSFORMATION OF AMERICAN LAW, 1870-1960: THE CRISIS OF LEGAL ORTHODOXY* 13 (1992).

22. *Id.*

23. *Brown v. Collins*, 53 N.H. 442 (1873); *Losee v. Buchanan*, 51 N.Y. 476 (1873). For the rise of the “negligence” and “fault” principles, see G. EDWARD WHITE, *TORT LAW IN AMERICA* 12-19 (1985).

24. It should be pointed out, however, that “legal science” is an elastic term, with a changing membership. Oliver Wendell Holmes, better known for his dissent in *Lochner v. New York*, 198 U.S. 45 (1905), turned out to be one of the most influential spokesmen for legal science in his championship of “negligence” in torts. See Oliver Wendell Holmes, *A Theory of Torts*, 7 AM. LAW REV. 652 (1873), reprinted in 44 HARV. L. REV. 773 (1931).

25. The overwhelming emphasis of legal science was on the private law of tort, contract, property, and commercial law. Public law, including constitutional law, was deemed hopelessly politicized and outside the scope of scientific study. The topics chosen for “restatement” by the American Law Institute were themselves revealing. The series included “Restatements” of the following: Agency (1923-33), Conflict of Law (1923-1934), Contracts (1923-1932), Judgments (1940-1942), Property (1927-1944), Restitution (1923-1937), Security (1936), Torts (1923-1939), and Trusts (1927-1935). See Goodrich, *supra* note 19, at 288-89.

26. Duncan Kennedy sees “classical legal thought” as a legal “consciousness” that encompassed laissez-faire constitutionalism. See Duncan Kennedy, *Toward a Historical Understanding of Legal Consciousness: The Case of Legal Thought in America, 1850-1940*, 3 RES. L. & SOC. 3 (1980). Grey cautions against an automatic connection. See Grey, *supra* note 7, at 34-35.

scientific knowledge seems to have been quite perfunctory, oblivious not only to the historical challenge of science but also to the new developments taking place in the very century in which he was writing. Forgetting that the rise of modern science had begun with an explicit repudiation of book-learning, a repudiation of a scholastic tradition based on exegesis and syllogism, Langdell saw no tension at all between the laboratory and the library. He turned a blind eye to the longstanding battle between knowledge acquired through empirical observation and knowledge acquired through “printed books.” Galileo’s *Dialogue on the Great World Systems*, after all, was as much a swipe at Aristotle as it was an astronomical treatise. Aristotle had a champion here: a character not surprisingly named Simplicius. For Simplicius, the ancient philosopher “was the first, only, and admirable explainer of the syllogistic forms of demonstration, of refutation, of the manner of discovering sophisms and paralogisms, and, in short, of all the parts of logic.”²⁷ Another character, Salvius, is not so sure. It makes no sense, he says, to “be so strictly wedded to every expression of Aristotle as to hold it heresy to disagree with him in anything.”²⁸ Galileo himself was certainly not wedded in this way. Nor was he wedded to the Bible, devout Christian though he was. As he explained to the Grand Duchess Christine:

In discussions of physical problems we ought to begin not from the authority of scriptural passages, but from sense-experiences and necessary demonstrations. . . . It is necessary for the Bible, in order to be accommodated to the understanding of every man, to speak many things which appear to differ from the absolute truth so far as the bare meaning of the words is concerned. But Nature, on the other hand, is inexorable and immutable; she never transgresses the laws imposed upon her, or cares a whit whether her abstruse reasons and methods of operation are understandable to men. For that reason it appears that nothing physical which sense-experience sets before our eyes, or which necessary demonstrations prove to us, ought to be called in question (much less condemned) upon the testimony of biblical passages.²⁹

The Bible is semantically ambiguous, Galileo said. To have a mass appeal, its words have to mean different things to different people. It is fork-tongued by necessity. This is not the case with Nature, which, indifferent to its human audience, is much more straightforward, its nonverbal evidence much more trustworthy than the deceptive statements from the Bible. No one is to be condemned for reasoning from that

27. GALILEO GALILEI, *DIALOGUE ON THE GREAT WORLD SYSTEMS* 42 (Salusbury trans., rev. by Giorgio de Santillana, Univ. of Chi. Press, 1953) (1631).

28. *Id.* at 53.

29. Galileo Galilei, Letter to Madame Christine of Lorraine, Grand Duchess of Tuscany (1615), in *DISCOVERIES AND OPINIONS OF GALILEO* 182, 182-83 (Stillman Drake ed., 1957).

nonverbal evidence rather than from sacred words.

This letter to the Grand Duchess Christine, written in 1615, was to prove prophetic. Eighteen years later, Galileo was indeed condemned because he had reasoned from the nonverbal evidence of nature rather than from the sacred words of the Bible. On January 20, 1633, under the threat of transportation under chains, Galileo was summoned before the Inquisition in Rome and, after three appearances, convicted of heresy at the age of sixty-nine. Kneeling, he was made to renounce his belief in the Copernican theory, in the earth's motion around the sun. "I abjure, curse, and detest the said errors and heresies."³⁰ That experience probably did little to strengthen his faith in the truth of sacred words. But, even before this fateful episode, words in general had never been a compelling medium of persuasion to Galileo. His astronomical observations were based not on texts, but on a different "book" altogether:

Philosophy is written in that great book which ever lies before our eyes—I mean the universe—but we cannot understand it if we do not first learn the language and grasp the symbols in which it is written. This book is written in the mathematical language, and the symbols are triangles, circles, and other geometrical figures, without whose help it is impossible to comprehend a single word of it.³¹

At its most extreme, Galileo's observational science saw itself as a rejection of *all* verbal knowledge. He rejected law and the humanities for just that reason: These text-based disciplines, "wherein there is neither truth nor falsehood," are almost as fork-tongued as the Bible itself.³² The "book" of nature is the only one that is not fork-tongued. It is such a book as will send written books to their graves, for it has no use for words at all. Its language is mathematics.

Galileo, of course, was not always so stringent, as his own prolific career as a writer demonstrated. Still, for early modern science, being "observational" almost always carried some degree of animus against bookishness, against the tyranny of text-based learning. It was in that spirit that the Royal Society of London, in 1663, chose as its motto this declaration of independence: "Nullius in Verba," nothing in words.³³

30. RAYMOND J. SEEGER, *GALILEO GALILEI, HIS LIFE AND HIS WORKS* 32 (1966).

31. GALILEO GALILEI, *THE CONTROVERSY ON THE COMETS OF 1618*, at 183-84 (Stillman Drake & C. D. O'Malley eds., 1960).

32. GALILEO, *supra* note 27, at 63.

If this of which we dispute were some point of law, or other part of the studies called the humanities, wherein there is neither truth nor falsehood, we might give sufficient credit to the acuteness of wit, readiness of answers, and the greater accomplishments of writers and hope that he who is most proficient in these will make his reason more probable and plausible. But the conclusions of Natural Science are true and necessary.

Id.

33. The motto was adopted from HORACE, *EPISTLES*, bk. I, ch. I, at 13-14: "Ac ne forte roges, quo me duce, quo lare tuter, Nullius addictus iurare in verba magistri." See SIR HENRY LYONS, F.R.S., *THE ROYAL SOCIETY, 1660-1940*, at 39 (1944).

Scientific inquiry would henceforth be conducted in a medium less treacherous and less futile than human language. And nothing better illustrated that treachery and that futility than syllogisms. The Royal Society gave these a wide berth. Its program (as stated by Robert Hooke) was a deliberate departure from text-based subjects: "To improve the knowledge of naturall things, and all useful Arts, Manufactures, Mechanick practises, Engines and Inventions by Experiments—not meddling with Divinity, Metaphysics, Moralls, Politicks, Grammar, Rhetoric or Logick."³⁴

Logic, constitutively dependent on language, had the same status as theology or metaphysics as far as the Royal Society was concerned.³⁵ Any knowledge derived from it is propositional derivation, parasitic on pre-assigned verbal entities. Such knowledge comes into being only by fiat, only by an arbitrary act of naming. Logic is thus conventional rather than natural. As such, its sweep is indeed infinite: It can generate a formally complete universe, a universe of self-defined and self-validating terms. But that only made it all the more suspect to experimental scientists of the seventeenth century. That suspicion was amply confirmed by later developments in mathematics. Early in the nineteenth century, a few decades before Langdell was writing, the discovery of several non-Euclidean geometries—by Karl Friedrich Gauss, Janos Bolyai, Nikolai Lobachevsky, and Bernhard Riemann—made it clear that logic, as a formal system of reasoning based on propositional derivation, was not in itself an adequate vehicle of knowledge.³⁶ The fact that space could be described by several systems of propositions, all logically consistent within themselves, meant that logical consistency was not a sufficient criterion of empirical truth. There is nothing wrong with the axioms of Euclid on the grounds of logic; they just don't always happen to describe the properties of physical space. Under some operative conditions, that space is better described by the axioms of other geometries, not Euclidean but just as logically consistent. Each system of formal logic, in short, is only *one* candidate among others to describe a particular physical event. Its candidacy sometimes comes to nothing. A crucial scientific

34. LYONS, *supra* note 33, at 41.

35. Of course, the degree of language-dependency is an open question. For an interesting contribution to this debate, see Noam Chomsky, who, in equating syntax with the cognitive substrate of mental events, in effect argues for an extremely close relation between logic and language. See NOAM CHOMSKY, *ASPECTS OF THE THEORY OF SYNTAX* (1965).

36. For the rise of non-Euclidean geometries, see BAS C. VAN FRAASSEN, *AN INTRODUCTION TO THE PHILOSOPHY OF TIME AND SPACE* 117-33 (1985). For a more technical account, see LAWRENCE SKLAR, *SPACE, TIME, AND SPACETIME* 13-54 (1974). To be fair to Langdell, I should point out that not everyone in the nineteenth century saw the discovery of non-Euclidean geometries as a decoupling of the physical from the logical. As late as 1883, Arthur Cayley, in his presidential address to the British Association for the Advancement of Science, could still assert that Euclid's parallel axiom "does not need demonstration, but is part of our notion of space—of the physical space of our experience." See MORRIS KLINE, *MATHEMATICS: THE LOSS OF CERTAINTY* 95 (1980).

development of the nineteenth century was thus the unforeseen shakiness of logic, it diminished referential claim. As Morris Kline says, "Non-Euclidean geometry was the reef on which the logic of Euclidean geometry foundered."³⁷ Out of that foundering would come Einstein's relativity in the twentieth century.³⁸

LAW AND LOGIC

All of this was lost on Langdell. His twin advocacy—of learning and of logic—was vulnerable to critique on a number of fronts, vulnerable, in fact, to the very charge of not being scientific." Oliver Wendell Holmes sounded the alarm in 1800 when, in his review of Langdell's *Summary of the Law of Contracts*, he made this pointed (and now celebrated) remark: "The life of the law has not been logic; it has been experience."³⁹ Fifteen years later—at a dinner in honor of Langdell, no less—Holmes tempered his critique only slightly. "The law, so far as it depends on learning," he said, is "the government of the living by the dead." "An ideal system of law should draw its postulates and its legislative justification from science," he went on, but (lest this be taken as an unmixed tribute to Langdell) he quickly added, "As it is now, we rely upon tradition . . . as our only warrant for rules which we enforce with as much confidence as if they embodied revealed wisdom."⁴⁰

Others, more conversant with science than either Langdell or, for that matter, Holmes, went further. Roscoe Pound—who wrote a doctoral dissertation on botany at the University of Nebraska⁴¹ while practicing law in that state, before moving on to his better known career, as law professor

37. KLINE, *supra* note 36, at 103.

38. The discovery of non-Euclidean geometries was especially important to Einstein. See Albert Einstein, *Geometry and Experience*, in IDEAS AND OPINIONS 232 (1954) and his discussion of Euclidean and non-Euclidean continua in RELATIVITY: THE SPECIAL AND GENERAL THEORY, 92-104 (Robert W. Lawson trans., 1961). For a critique of a different logical formalism—Kant's—by the Vienna Circle, a critique that also draws on non-Euclidean geometry and Einstein, see RUDOLF CARNAP, *Kant's Synthetic A Priori*, in AN INTRODUCTION TO THE PHILOSOPHY OF SCIENCE 177 (Martin Gardner ed., 1995).

39. Oliver Wendell Holmes, Review of Langdell's *Summary of the Law of Contracts*, 14 AMER. L. REV. 233 (1880). This sentence was then incorporated into the opening paragraph of THE COMMON LAW. See OLIVER WENDELL HOLMES, THE COMMON LAW 1 (1881).

40. Oliver Wendell Holmes, Learning and Science, Speech at a Dinner of the Harvard Law School Association in Honor of Professor C.C. Langdell (June 25, 1895), in THE MIND AND FAITH OF JUSTICE HOLMES: HIS SPEECHES, ESSAYS, LETTERS, AND JUDICIAL OPINIONS 34-35 (Max Lerner ed., 1943).

41. Pound's doctoral dissertation on botany at the University of Nebraska was eventually published, in revised form, as ROSCOE POUND & FREDERIC E. CLEMENTS, PHYTOGEOGRAPHY OF NEBRASKA (1898). Arthur Sutherland, discussing Pound's better known work, OUTLINES OF LECTURES ON JURISPRUDENCE (1898), comments: "One interested in Pound's intellectual tendencies does well to consider the nature of this book. It suggests his PHYTOGEOGRAPHY OF NEBRASKA; it is a book of scientific ordering, of minutely detailed nomenclatural terms. Here is a botanist, explaining the taxonomy and nomenclature of justice." See ARTHUR SUTHERLAND, THE LAW AT HARVARD: A HISTORY OF IDEAS AND MEN, 1817-1967, at 237 (1967).

and then Dean of the Harvard Law School—was able to draw on this unusual background to chide his predecessor. “But what do we mean by the word ‘scientific’? What is scientific law? What constitutes science in the administration of justice?” Pound began, and quickly noted that a wholesale equation of science with logic was no longer tenable: “We no longer hold anything scientific merely because it exhibits a rigid scheme of deductions from *a priori* conceptions. . . . The idea of science as a system of deductions has become obsolete.”⁴² He then pointed to biology:

Linnaeus, for instance, lays down a proposition, *omne vivum ex ovo*, and from this fundamental conception deduces a theory of homologies between animal and vegetable organs. He deemed no study of the organisms and the organs themselves necessary to reach or to sustain these conclusions. Yet, today, study of the organisms themselves has overthrown his fundamental proposition.⁴³

This is what empiricism means, Pound said. And “the revolution which has taken place in other sciences in this regard must take place and is taking place in jurisprudence also.”⁴⁴ Jurisprudence, in other words, must become “scientific” in the following sense:

[I]t must be judged by the result it achieves, not by the niceties of its internal structure; it must be valued by the extent to which it meets its end, not by the beauty of its logical processes or the strictness with which its rules proceed from the dogmas it takes for its foundation.⁴⁵

Pound was, of course, speaking more as a lawyer than as a scientist. Still, it was no small help that he was able to point to a conception of science more up-to-date and more rigorous than Langdell’s. For Langdell, logical consistency was what made law scientific: This alone was enough, it was a necessary and sufficient criterion. For Pound, it was not enough. A body of law can be logically impeccable and legally unacceptable. It becomes acceptable only if it has something else to show: some achieved result, some progress toward the end it proposes. This consequentialist criterion puts the burden of proof outside law itself, external to anything formalizable on its own terms. It also removes from law any self-testing mechanism, any integral procedure for verification or even falsification.⁴⁶ Whether law can still be called “scientific” is an interesting question, but it was not one Pound pursued. Instead, from a consequentialist standpoint (and the standpoint of an ex-botanist), he now proceeded to give an

42. Roscoe Pound, *Mechanical Jurisprudence*, 8 COLUM. L. REV. 605, 605, 608 (1908).

43. *Id.* at 609.

44. *Id.* at 608.

45. *Id.* at 605.

46. I take the word from Karl Popper, who argues that scientific testability is based, not on the broad criterion of verifiability, but on the much more limited criterion of falsifiability. See KARL POPPER, *THE LOGIC OF SCIENTIFIC DISCOVERY* 78-92 (1992).

empirical account of what happened when law was aligned too closely with one particular conception of science, when logic was deemed its sole arbiter.

Pound cited the “scientific” affirmation of the liberty of contract in *Lochner* and *Adair*⁴⁷; he also cited a much wider range of judicial failings:

its inadequacy to deal with employers’ liability; the failure of the theory of ‘general jurisprudence’ of the Supreme Court of the United States to give us a uniform commercial law; the failure of American courts, with centuries of discussion before them, to work out a reasonable or certain law of future interests in land; the breakdown of the common law in the matter of discrimination by public service companies because of inability to make procedure enforce its doctrines and rules; its breakdown in the attempt to adjust water rights in our newer states, where there was opportunity for free development; its inability to hold promoters to their duty and to protect the interests of those who invest in corporate enterprises against mismanagement and breach of trust; its failure to work out a scheme of responsibility that will hold legal entities, or those who hide behind their skirts, to their duty to the public.⁴⁸

All of these happened when law was modeled on an impoverished notion of science. Modeled in this way, a “scientific jurisprudence becomes a mechanical jurisprudence.”⁴⁹

Principles were no longer resorted to in order to make rules fit cases. The rules were at hand in a fixed and final form, and cases were to be fitted to the rules. The classical jurisprudence of principles had developed, by the very weight of its authority, a jurisprudence of rules; and it is the nature of rules to operate mechanically.⁵⁰

More at home in science than Langdell, Pound also had a keener sense of what might go wrong when science was known superficially, known only as a label, when its alleged rules of operation were touted as absolute rules in another quarter. Being “mechanical” is sometimes a good thing in science: It furnishes a kind of impersonal guarantee, the guarantee that certain outcomes will always follow from certain experimental conditions, irrespective of who is doing the experiment, where or when it is being done. Generalizability and predictability are the virtues of a “mechanical” science. These virtues do not carry over undiminished into another discipline. A “mechanical” jurisprudence, Pound argued, has the defects of its virtues. Generalizability and predictability are here purchased at the cost of stripping each case of its particulars to fit it into the preassigned

47. *Lochner v. New York*, 198 U.S. 45 (1905); *Adair v. United States*, 208 U.S. 161 (1908).

48. Pound, *supra* note 42, at 614.

49. *Id.*

50. *Id.* at 607.

categories of the law, boxing individual circumstances into the law's generalized technical language. Formal order is the pride of this language, but also its hazard. For the more formal the language, the cleaner its taxonomic categories, the less likely it is to capture the messy details of each dispute.⁵¹ A "mechanical" jurisprudence is mechanical in the sense that it is automated, unencumbered: well-defined rules applied to well-defined entities. For Pound, that was the problem.

And here, quoting William James, Pound suggested that a logic-based legal "science" is actually not far from something that has no pretensions to being science at all—namely, a primitive nominalism, a magical belief in the power of words and formulae to solve problems and restore order.⁵² A legal language answerable only to its own logic is the latest installment of this magical belief:

Current decisions and discussions are full of such solving words: estoppel, malice, privity, implied, intention of the testator, vested and contingent—when we arrive at these we are assumed to be at the end of our juristic search. Like Habib in the Arabian Nights, we wave aloft our scimitar and pronounce the talismanic word.⁵³

Pound was, of course, not one of the legal realists, but their best-known critic, sharply responded to as such by Karl Llewellyn.⁵⁴ Still, as Llewellyn himself later acknowledged, "half of the commonplace equipment" of the realist jurisprudence had actually been outlined by Pound, who had contributed "more than any other individual (unless perhaps John Dewey) to making legal thought in this country result-minded, cause-minded, and process-minded."⁵⁵ Pound's critique of

51. The realists' call for more minute classifications is a response to the unfairness perpetrated when legal categories are overly broad. Karl Llewellyn writes of "the worthwhileness of grouping cases and legal situations into narrower categories than has been the practice in the past. This is connected with the distrust of verbally simple rules—which so often cover dissimilar and non-simple fact situations." See Llewellyn, *supra* note 1, at 1237.

52. The passage by James quoted by Pound is from Lecture 2, *What Pragmatism Means*, in *PRAGMATISM* (1943):

Metaphysics has usually followed a very primitive kind of quest. You know how men have always hankered after unlawful magic, and you know what a great part in magic words have always played. If you have his name, or the formula of incantation that binds him, you can control the spirit, genie, afrite, or whatever the power may be. . . . So the universe has always appeared to the natural mind as a kind of enigma of which the key must be sought in the shape of some illuminating or power-bringing word or name. That word names the universe's principle, and to possess it is after a fashion to possess the universe itself. "God," "Matter," "Reason," "the Absolute," "energy," are so many solving names. You can rest when you have them. You are at the end of your metaphysical quest.

Id. at 52.

53. Pound, *supra* note 42, at 612.

54. Compare Roscoe Pound, *The Call for a Realist Jurisprudence*, 44 HARV. L. REV. 697-711 (1931), with Karl Llewellyn, *supra* note 1, at 1222-64. For a more detailed account of Pound's rejection of legal realism, see KALMAN, *supra* note 5, at 45-66.

55. KARL LLEWELLYN, *Roscoe Pound*, in *JURISPRUDENCE: REALISM IN THEORY AND PRACTICE* 496, 501 (1962). For a discussion of Pound and legal realism, see WILFRED RUMBLE, *AMERICAN*

“mechanical jurisprudence,” for instance, would be repeated and amplified by Jerome Frank.⁵⁶ Likewise, his critique of the “talismanic” language of law would be a spur to Felix Cohen’s polemics against “transcendental nonsense,” against “legal magic and word-jugglery.”⁵⁷

A rejection of mechanical jurisprudence—with Cohen as with Pound—hardly meant a rejection of science itself.⁵⁸ Quite the contrary. In Cohen’s mind, these two were entirely distinct and he, for one, was eager to claim the latter, claim it as his sole and exclusive ally, not admitting his opponents into the fold. And so, in his hands (and in the hands of other polemicists such as Jerome Frank), the Langdellian model suddenly became portrayed as a retrograde, quasi-religious faith, a latter-day scholasticism which the realists, as empirical lawyers, must do their best to demolish.⁵⁹ The critique of logic, rules of law, *stare decisis*—the typical realist agenda—turned out to be fueled by this burning question: “How are we going to substitute a realistic, rational, scientific account of legal happenings for the classical theological jurisprudence of concepts?”⁶⁰

Cohen might well have heeded Pound here. There is always the danger, Pound has cautioned, that law might become “too scientific,”⁶¹ pushing too far its analogy to a discipline whose domain of inquiry is after all quite different. And the worst way of being too scientific is to push the analogy to a term that is itself no more than a label: a term hardened into a convenient clarity, hardened into a unified whole at just those points where its dissonances are most explosive and most interesting. A blanket invocation of science—offered both by Langdell and by some of his realist critics—coarsens both what is invoked and those who invoke it. As Pound shows by his contrary example, it is more helpful to explore shades and gradations: the extent to which science might be a good analogy for law, the extent to which it might not. Science, invoked in this consciously qualified way, becomes a sounding board, a heuristic companion. It brings

LEGAL REALISM (1968) and G. Edward White, *From Sociological Jurisprudence to Realism: Jurisprudence and Social Change in Early Twentieth-Century America*, 58 VA. L. REV. 999-1028 (1972).

56. See JEROME FRANK, *Mechanistic Law; Rules; Discretion; The Ideal Judge*, in *LAW AND THE MODERN MIND*, *supra* note 4, at 127.

57. Felix Cohen, *supra* note 3, at 821.

58. Several other realists were also science enthusiasts—especially Walter Wheeler Cook. As an undergraduate at Columbia, Cook studied mathematics and physics. After graduation, he took an instructorship in mathematics and, a year later, headed off to Germany for a two-year fellowship in physics. After returning to the United States, he was still hired as an assistant in the Mathematics Department, even though he was simultaneously enrolled both in the Law School and in the School of Political Science. See JOHN HENRY SCHLEGEL, *AMERICAN LEGAL REALISM AND EMPIRICAL SOCIAL SCIENCE* 28 (1995). For a thorough-going attempt to invoke physics as a model for law, see Walter Wheeler Cook, *supra* note 8, at 303.

59. For Jerome Frank’s critique of the Langdellian orthodoxy as Scholasticism, see FRANK, *supra* note 4, at 62-74.

60. Cohen, *supra* note 3, at 821.

61. Pound, *supra* note 42, at 606.

into relief what is formalizable in law and what is not, what falls inside and outside the scope of logic. What exactly is the relation between law and its decisional rules? How far can these rules be generalized from precedents, and how far can they be extended to cases in the distant future? Is law a social “science,” as some of the realists claimed,⁶² and what does that word mean in any case? Where does this “science” stand among the natural sciences? Does it have anything to say in return to the scientists?

LAW-ABIDINGNESS

I will address these questions briefly by focusing on one concept pertinent to science and jurisprudence both: law-abidingness. In picking this focus, I hope to suggest three intersecting but ultimately diverging lines of inquiry. First, as will become clear, law-abidingness is a concept that falls with uneven weight across the sciences, for “laws of science” in fact mean very different things in physics and biology. The concept can thus serve as a critical wedge, an axis of differentiation, breaking down the apparent unity of a too-handy label. In highlighting the disagreements among scientists, it highlights as well the heuristic value of a contested definition of science.⁶³ Secondly, while law-abidingness is not a word prominently featured in the realists’ vocabulary, it is nonetheless an issue implicitly raised by their critique of rules of law. Realists imagined the world to be law-abiding, but only up to a certain point. The world is not so law-abiding that rules can cover all judicial action; it is not so law-abiding that an ironclad forecast can be made of what judges and juries will do. This seems to me a very powerful argument. And it is one that can be transposed, mapped, and investigated on a different analytic register. Rather than dwelling on the unpredictability of courtroom decision and its pressures on legal rules, I want to shift the frame to the unpredictability of technological change and its pressures on existing bodies of law. To address law-abidingness in this transposed context is to ask whether law is diachronically binding, whether its jurisdiction is a jurisdiction over time.

Finally, in bringing forth the diachronic as a challenge to the conceptual order of law, I hope to issue a challenge as well to cultural studies, complicating and broadening its focus on the institutional entanglements of cultural forms. Cultural studies, as it is currently practiced, is overwhelmingly synchronic both in its subject matter and in its methodology. Institutional entanglements are here assumed to be contemporaneous, to operate within the same slice of time. This slice of

62. This is not my view, but see John Henry Schlegel, *American Legal Realism and Empirical Social Science: From the Yale Experience*, 28 BUFF. L. REV. 459 (1980), expanded into his *AMERICAN LEGAL REALISM AND EMPIRICAL SOCIAL SCIENCE* (1995).

63. See, e.g., *THE DISUNITY OF SCIENCE* (Peter Galison & David J. Stump eds., 1996).

time is further assumed to be an adequate sample, adequate in its descriptive and explanatory power. A diachronic approach unsettles these assumptions. It highlights not only the crucial fact of change across time but also the unevenness of that change: emerging phenomena not emerging at the same rate or even on the same plane, changing the dynamics of the cultural fabric at any given moment, and assigning a new functional meaning even to terms that might look the same. The natural sciences highlight the diachronic. Both in their debates over the degree of determination ascribable to sequence (a debate central to the history of the universe in astrophysics and to the role of chance in evolutionary biology), and, more directly experienced by us, in their ability to foster rapid technological change, the sciences give us a world in which time is a major player. In both respects, they are a vital part of cultural studies, their importance long overlooked.⁶⁴

Without further ado, then, I proceed to the sciences, to see how the concept of law-abidingness holds up. "Laws of science" is a time-honored concept, idiomatic in its usage. Rudolf Carnap gives a classic definition:

If a certain regularity is observed at all times and all places, without exception, then the regularity is expressed in the form of a "universal law." An example from daily life is "All ice is cold." This statement asserts that any piece of ice—at any place in the universe, at any time, past, present, or future—is (or was, or will be) cold.⁶⁵

Universal laws are propositions whose domain of validity is unlimited: Their binding power extends to any point in space, any point in time. While Carnap calls these propositions laws of "science," in fact they are almost exclusively laws of physics. As such, they are mathematical laws, with properties perhaps not immediately discernible in the example of ice.

Richard Feynman offers a more standard example, one most physicists would agree to be a law:

The Law of Gravitation is that two bodies exert a force upon each other which varies inversely as the square of the distance between them, and varies directly as the product of their masses. Mathematically we can write that great law down in the formula:

$$F = G \frac{mm'}{r^2}$$

64. An important exception here is FRED INGLIS, *CULTURAL STUDIES* (1993). Inglis argues that cultural studies, "in its anti-scientific dialectic, will still have to incorporate the scientific canons of method. . . . While the human sciences cannot of their nature make much play with laboratory conditions of proof, or at least of falsifiability, it is now surely reasonable to speak of experiential and historical proof." Inglis calls for "a level of competence on our part at least going as far as the first year of university study in, say, statistics and one of the life sciences." *Id.* at 111-12.

65. Rudolf Carnap, *The Value of Laws: Explanation and Prediction*, in *AN INTRODUCTION TO THE PHILOSOPHY OF SCIENCE* 3 (Martin Gardner ed., 1995).

some kind of a constant multiplied by the product of the masses, divided by the square of the distance. Now if I add the remark that a body reacts to a force by accelerating, or by changing its velocity every second to an extent inversely as its mass, or that it changes its velocity more if the mass is lower, inversely as the mass, then I have said everything about the Law of Gravitation that needs to be said. Everything else is a mathematical consequence of those two things.⁶⁶

Even though gravity started out as an empirical observation, to be stated as a law, it must take the form of a generalization, a description not in terms of the individual features of the objects, but in terms of two abstract attributes: distance and mass. And because these attributes are expressed in that least ambiguous of languages—mathematics—the binding power of this generalization is indeed spectacular. Everything that needs to be said is already there, and “everything else is a mathematical consequence.” The Law of Gravitation is complete. The world it describes is law-abiding to the extreme, because under a given operative condition there is just one script, featuring the same sequence of events and coming out exactly the same way. It is a script that can be repeated over and over again, a script that can be predicted down to the smallest detail. And it is a script that changes not at all over time. As Feynman says, “But the most impressive fact is that gravity is simple. It is simple to state the principles completely and not have left any vagueness for anybody to change the ideas of the law.”⁶⁷ This law is here for good. Its reign began before Newton discovered it in the seventeenth century, and will endure till the end of time.⁶⁸

Feynman’s laws have diachronic binding powers no man-made laws can match. This is not a trivial insight. In fact, the heuristic value of physics is just this: It is not a good analogy.⁶⁹ Its “laws” dramatize a semantic usage so exacting as to be out of reach for everyone but a physicist. Jurisprudence can never yield the same kind of law-abidingness that gravity does. To be functional, then, the word “laws” cannot have the

66. RICHARD FEYNMAN, *THE CHARACTER OF PHYSICAL LAW* 14-15 (1995).

67. *Id.* at 33.

68. I do not want to discuss quantum mechanics here, but I do want to point out that the so-called “indeterminacy” attributed to quantum mechanics is actually not an absolute statement about indeterminacy, and certainly not a statement about change across time. Instead, it is a statement about the relative distribution of indeterminacy between two well-defined terms, velocity and spatial location: The more precise we are about one, the less precise we are about the other. See 3 NIELS BOHR, *Quantum Physics and Philosophy—Causality and Complementarity*, in *THE PHILOSOPHICAL WRITINGS OF NIELS BOHR, ESSAYS 1958-1962 ON ATOMIC PHYSICS AND KNOWLEDGE* 1-7 (1987). An interesting recent challenge to the diachronic invariance of physical laws is Lee Smolin’s argument that physical laws might have “evolved,” and are different now from what they used to be at the beginning of time. See LEE SMOLIN, *LIFE OF THE COSMOS* (1997).

69. I do not mean to suggest that physics is not a good analogy *tout court*, only that its conception of “law-abidingness” is more stringent than can be upheld in any other discipline. For an attempt to connect physics, law, and literature within a different configuration, see my *Rethinking Space, Rethinking Rights: Literature, Law, Science*, 10 *YALE J.L. & HUMAN.* 487 (1998).

same definition everywhere; it must mean different things to practitioners of different disciplines. These different meanings do not create an unpassable gulf between law and the sciences as a whole, for, in differing from physics, law is actually in good scientific company.

Another branch of science—biology—is on record as differing from physics in just this way. Ernst Mayr, a pivotal figure in modern evolutionary biology, is nothing if not explicit here. “Since the Scientific Revolution,” Mayr says, “the philosophy of science has been characterized by an almost exclusive reliance on logic, mathematics, and the laws of physics.”⁷⁰ Biology does not come under this mantle. Its unique contribution, in fact,

is the deemphasis of laws. In most classical philosophies of science, explanation consists in connecting phenomena with laws. Although laws are also encountered in biology, particularly in physiological and developmental processes, most regularities encountered in the living world lack the universality of the laws of physics. Consequently biologists nowadays make use of the word *law* only rarely.⁷¹

Laws are necessary to the constitution of physics as a discipline; without their ability to generalize and to predict, physics would not be physics. For most biologists, this is not true.⁷² In this discipline, laws are local, occasional, good for the most part, but rarely blessed with the power to clinch the case once and for all. Mayr mentions many reasons for the limited scope of laws in his discipline. These include the centrality of chance in evolution; the nonderivability of a discrete cause from any given effect; the absence of any genetic rules to govern the ordering of phenotypes; and the emergence of unforeseeable functions and properties at every level of aggregation. All of these make predictions and generalizations difficult.⁷³

Even a mantra that might look like a law in molecular biology—that “DNA makes proteins”—turns out to be less than what it appears, as Richard Lewontin argues:

Not *all* the information about protein structure is stored in the DNA sequence, because the folding of polypeptides into proteins is not

70. ERNST MAYR, *Preface to TOWARD A NEW PHILOSOPHY OF BIOLOGY*, at v (1988).

71. *Id.* at vi.

72. I should point out, however, that there is an important minority opinion directly challenging the mainstream represented by Mayr. Rupert Riedl argues vigorously for a law-abiding, predictable order in biology, one that can be captured by induction. See Rupert Riedl, *A Systems-Analytical Approach to Macro-Evolutionary Phenomena*, 52 Q. REV. OF BIOLOGY 351 (1977). Recent work in mathematical population genetics supports Riedl, making predictions and generalizations much more central to biology, since there appears to be a mathematical correlation between the complexity of an organism and the degree of freedom open to its developmental pathways. See Günter Wagner, *Complexity Matters*, 279 SCIENCE 1158 (1998).

73. See generally MAYR, *supra* note 70, at 1-66.

completely specified by their amino acid sequences. . . . We do not, in fact, know what the rules of protein folding are, so no one has ever succeeded in writing a computer program that will take the sequence of amino acids in a polypeptide and predict the folding of the molecule. Even programs that attempt very crude characterizations of the folding of regions of proteins into major structural classes like alpha-helices and beta-sheets are not more than about 75 percent accurate.⁷⁴

The folding of proteins does not follow a law laid down by DNA sequences, because there are numerous other intervening forces: the environment as both cause and effect; the complex molecular interactions within the organism itself; and finally, strictly random processes, the “developmental noise” of the organism. Inveterate messiness is the result. Wrestling with that fact, Lewontin comes up with this analogy:

In the United States, which is broken up into separate state governments with different laws, it is often impossible to say what law will hold without knowing in which state the question has arisen. When asked a question, an American lawyer will reply, “It depends on the jurisdiction.” So too, in biology, it depends on the jurisdiction.⁷⁵

For Lewontin, law sheds light on biology. The obverse is no less true. In both disciplines, laws come with brackets, with qualifiers. In both disciplines, predictions and generalizations go only so far, because contextual variables are too numerous and too random to be fully formalizable. This fact alone suggests that, if there is indeed a “legal science,” it might not take the form envisioned by Langdell.

LAW ACROSS TIME

But biology is not just a heuristic companion for jurisprudence; it is also a technology, an agent of change, that encroaches upon existing bodies of law, changing the functional meaning of its terms and changing its conceptual order in that process. The recent completion of the Human Genome Project is a case in point. This scientific breakthrough rewrites the grounds rules for medicine, putting genetic information and high-tech procedures at its front and center. In doing so, it also multiplies the conundrum of intellectual property, putting conflicting interpretations on this phrase, and putting pressure as well on the jurisdictional boundary between the courts and the legislature. What exactly is a “patent” and what exactly is “patentable”? When does information come under the rule of an ownership claim? And who is to determine its scope and legitimacy?

74. RICHARD LEWONTIN, *THE TRIPLE HELIX: GENE, ORGANISM, AND ENVIRONMENT* 73-74 (2000).

75. *Id.* at 87-88.

Should this question be litigated in court, or should it be conducted as a public policy debate, resulting in legislative action?

The newfangled techniques of gene therapy had brought these questions to a head even before the Human Genome Project was completed. In September 1990, a team at the National Institutes of Health (NIH) used this highly experimental technique for the first time on a human being, the four-year-old Ashanthi DeSilva. DeSilva, along with another child, had suffered from a lethal genetic disorder: Their bodies failed to produce an enzyme called adenosine deaminase, or ADA, which the body needs in order to produce disease-fighting white blood cells. Since the disorder involves the mutation of only a single gene, it is an especially good target for gene therapy. The medical team, headed by the renowned W. French Anderson, used an *ex vivo* technique: They took from DeSilva some white blood cells called T cells, multiplied these outside the body, then mixed them with a therapeutic virus, a virus disarmed and injected with a normal ADA gene. This normal ADA gene was transferred by the virus to the T cells, which were then returned to the body, spreading the cure. And cure it was. By all accounts, the technique was a stunning success. Thanks to it, both children are now living near-normal lives. Meanwhile, Anderson and two other members of his team filed for and received a U.S. patent on every kind of human *ex vivo* gene therapy.⁷⁶

Anderson's scientific colleagues reacted with "deep disbelief."⁷⁷ The breadth of the patent meant that an entire category of medical procedures was now under its control. As one researcher said, "This is analogous to giving someone a patent for heart transplants."⁷⁸ Even though NIH holds the patent, the administration of the patent—facilitated by the Bayh-Dole Act (1980)⁷⁹—was granted to a private company, Genetic Therapy Inc. (GTI), which had jointly funded the research and whose scientific board Anderson chaired. GTI was granted an exclusive licensing right, giving it the power to "pick and choose winners in a very young field," since anyone commercializing an *ex vivo* gene therapy in the United States would have to buy a sub-license from the company.⁸⁰ Nor was this all. Within three months of the gene therapy patent, GTI was sold for \$295 million to the Swiss pharmaceutical giant, Sandoz, which in turn merged with its rival, Ciba-Geigy, in a \$63 billion merger to form a new conglomerate called Novartis. As a result, the licensing right to the *ex vivo* gene therapy patent is now in the hands of a multinational corporation of

76. See SETH SHULMAN, OWNING THE FUTURE 43-54 (1999); Helen Gavaghan, *NIH Wins Patent on Basic Technique Covering All Ex Vivo Gene Therapy*, NATURE, Mar. 30, 1995, at 393.

77. Gavaghan, *supra* note 76, at 393.

78. *Id.*

79. The Bayh-Dole Act (1980) gave private institutions ownership of inventions by publicly funded researchers. For the legislative history, see LINDA MARSA, PRESCRIPTION FOR PROFITS 96 (1997).

80. Gavaghan, *supra* note 76, at 393.

truly breath taking proportions: the world's largest agrochemical company, second largest seed company, third largest pharmaceutical company, and fourth largest veterinary medicine company.⁸¹

The trajectory of this patent could never have been foreseen by the Framers of the Constitution. Under Article I, Section 8 of that document, the Framers instructed Congress to "promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."⁸² Congress responded with two landmark statutes: the patent act and the copyright act, the former of which was signed by George Washington on April 10, 1790. Even then, not everyone believed in patents. Jefferson, an active inventor (and one of the three members on the Board of Patent Commissioners), never filed for one. Neither did Benjamin Franklin, or Joseph Henry, the inventor of the first electric motor, who saw patents as a roadblock to free inquiry, a low tactic to which no "true man of science" would stoop.⁸³ Early patents were, in any case, quite different from their latter-day offsprings. In the late eighteenth century, patentability was firmly grounded in tangible objects. Applicants for patents were required to submit physical models of their inventions, along with verbal and graphic descriptions.⁸⁴ This practice was discontinued in 1869, and, in the century that followed, patents were granted increasingly not to specific devices but to broad areas of actionable knowledge such as medical procedures, the chemical composition of drugs, and programming techniques for software applications.⁸⁵

The word "patent" remains the same, but it is clearly not what it used to be. The changing meaning of that word—not to mention its changing contexts of usage—amply affirms what Galileo had suspected long ago: that law is a linguistic artifact, dependent on words and haunted by that dependency. Such an artifact is susceptible to time; it can easily be altered out of recognition. As words change their meaning, so too do laws whose wording might remain superficially the same. To enforce the letter of the law is paradoxically to depart from its original meaning, changing its scope, its mode of operation, getting it tangled up in complications entirely unforeseen. In this way, jurisprudence is plagued by all the hazards and all the treacheries of text-based knowledge. "Nullius in Verba" is an ideal it can never attain, never even pretend to champion.

The dream of a "legal science"—the dream of Langdell, as of his realist

81. SHULMAN, *supra* note 76, at 48-49.

82. U.S. CONST. art. I, § 8.

83. Cathleen Schurr, *Two Hundred Years of Patents and Copyrights*, AM. HIST. ILLUSTRATED, July-Aug. 1990, at 60, 63.

84. *Id.*

85. For an argument against patents in software, see, for instance, Simson L. Garfinkel, Richard M. Stallman & Mitchell Kapo, *Why Patents Are Bad for Software*, in HIGH NOON ON THE ELECTRONIC FRONTIER 35 (Peter Ludlow ed., 1996).

critics—must be seen in this light. Science as an analogy for law works only up to a point. It ceases to work at just that point where the sciences have succeeded in securing for themselves a domain of inquiry and a body of knowledge arguably not text-based. Jurisprudence will look in vain here for a parallel understanding of the temporal vicissitudes of language. It is at this point, at the limits of science as analogy, that we must look elsewhere, to another heuristic ally no less important, though important for different reasons. The humanities have little to offer in the way of rules. Neither prediction nor generalization is their strong suit. Still, as a repository of words transmitted across time, interpreted and reinterpreted across time, the humanities do have something to say about what it means to be diachronically predicated, a predication not unlike Benjamin Cardozo's vision of jurisprudence:

We may think the law is the same if we refuse to change the formulas. The identity is verbal only. The formula has no longer the same correspondence with reality. Translated into conduct, it means something other than it did. Law defines a relation not always between fixed points, but often, indeed oftenest, between points of varying position. The acts and situations to be regulated have a motion of their own. There is change whether we will it or not.⁸⁶

86. BENJAMIN CARDOZO, *THE PARADOXES OF LEGAL SCIENCE* 11 (Greenwood Press, 1970) (1928).

